CLAIMS:

1. An interferometer optical switch comprising an optical waveguide circuit including:

a first optical multi/demultiplexing device;

an optical delay line including two optical waveguides connected to said first optical multi/demultiplexing device;

a second optical multi/demultiplexing device connected to said optical delay line;

one or more input waveguides connected to said first optical multi/demultiplexing device;

one or more output waveguides connected to said second optical multi/demultiplexing device; and

a phase shifter installed in said optical delay line, and wherein

at least one of said first optical multi/demultiplexing device and said second optical multi/demultiplexing device is a phase generating coupler, which produces a wavelength-dependent phase difference.

2. The interferometer optical switch as claimed in claim 1, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is

the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

3. The interferometer optical switch as claimed in claim 2, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

4. The interferometer optical switch as claimed in claim 2, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

5. The interferometer optical switch as claimed in claim 2, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase

differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

6. The interferometer optical switch as claimed in claim 1, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

7. The interferometer optical switch as claimed in claim 1, wherein

said phase generating coupler is configured by connecting optical couplers and optical delay lines.

8. The interferometer optical switch as claimed in claim 7, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device,

$2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

9. The interferometer optical switch as claimed in claim 8, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

10. The interferometer optical switch as claimed in claim 4, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

11. The interferometer optical switch as claimed in claim

8, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

12. The interferometer optical switch as claimed in claim 7, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

13. The interferometer optical switch as claimed in claim 7, wherein

said phase generating coupler comprises N + 1 optical couplers (N is a natural number), and N optical delay lines that connects adjacent optical couplers of said N + 1 optical couplers.

14. The interferometer optical switch as claimed in claim 13, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

15. The interferometer optical switch as claimed in claim 14, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

16. The interferometer optical switch as claimed in claim 14, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio

of said second optical multi/demultiplexing device are made equal.

17. The interferometer optical switch as claimed in claim 14, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

18. The interferometer optical switch as claimed in claim 13, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

19. The interferometer optical switch as claimed in claim 7, wherein

one of said first optical multi/demultiplexing device

and said second optical multi/demultiplexing device is an optical coupler with a phase difference $2\pi\phi_c$ (constant), and the other is a phase generating coupler that is composed of two optical couplers and an optical delay line placed between said two optical couplers, and has a phase difference $2\pi\phi$ (λ), and wherein

assuming that ΔL is the optical path length difference of the optical delay line, and m is an integer, then the power coupling ratios of the two optical couplers constituting said phase generating coupler, and the optical path length difference of the optical delay line are set to satisfy

$$\phi(\lambda) = \Delta L/\lambda + m/2 - \phi_c \qquad (11).$$

20. The interferometer optical switch as claimed in claim 19, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase

differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

21. The interferometer optical switch as claimed in claim 19, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

22. The interferometer optical switch as claimed in claim 19, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase

produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

23. The interferometer optical switch as claimed in claim 7, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device are both a phase generating coupler comprising two optical couplers and a single optical delay line placed between said two optical couplers, and wherein

power coupling ratios of the two optical couplers and an optical path length difference of the optical delay line that constitutes the first and second optical multi/demultiplexing device are set such that the sum of the phase difference $2\pi\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $2\pi\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device satisfies

$$\phi_1(\lambda) + \phi_2(\lambda) = \Delta L/\lambda + m/2 \qquad (12)$$

where ΔL is the optical path length difference of said optical delay line, and m is an integer.

24. The interferometer optical switch as claimed in claim 23, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1) \cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

25. The interferometer optical switch as claimed in claim 23, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is

the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive,

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

26. The interferometer optical switch as claimed in claim 23, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

27. The interferometer optical switch as claimed in claim 7, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device are both a phase

generating coupler comprising N + 1 optical couplers (N is a natural number), and N optical delay lines each of which is composed of a first and second optical waveguides, and which connects adjacent optical couplers of the N + 1 optical couplers, and wherein

the sum of the optical path length satisfies either ($\Sigma\delta l_{1,1} > \Sigma\delta l_{2,1}$ and $\Sigma\delta l_{1,2} > \Sigma\delta l_{2,2}$), or ($\Sigma\delta l_{2,1} > \Sigma\delta l_{1,1}$ and $\Sigma\delta l_{2,2} > \Sigma\delta l_{1,2}$)

, where $\Sigma\delta l_{1,1}$ is the sum of optical path length differences of the first optical waveguide constituting the N optical delay lines of said first optical multi/demultiplexing device, $\Sigma\delta l_{2,1}$ is the sum of optical path length differences of the second optical waveguide, $\Sigma\delta l_{1,2}$ is the sum of optical path length differences of the first optical waveguide constituting the N optical delay lines of said second optical multi/demultiplexing device, and $\Sigma\delta l_{2,2}$ is the sum of optical path length differences of the second optical waveguides constituting the N optical delay lines of said second optical multi/demultiplexing device.

28. The interferometer optical switch as claimed in claim 27, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical

multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

29. The interferometer optical switch as claimed in claim 28, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

30. The interferometer optical switch as claimed in claim 28, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

31. The interferometer optical switch as claimed in claim 28, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the

sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

32. The interferometer optical switch as claimed in claim 27, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

33. The interferometer optical switch as claimed in claim 27, wherein

the power coupling ratios of the N + 1 optical couplers of said first optical multi/demultiplexing device are made equal to the power coupling ratios of the N + 1 optical couplers of said second optical multi/demultiplexing device.

34. The interferometer optical switch as claimed in claim 33, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer), wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

35. The interferometer optical switch as claimed in claim 33, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an

integer); wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

36. The interferometer optical switch as claimed in claim 33, wherein

assuming that optical wavelength is λ, a phase difference between light output from said first optical multi/demultiplexing device is $2\pi\phi_1(\lambda)$, a phase difference caused by an optical path length difference ΔL of said optical delay line is $2\pi\phi\Delta_L(\lambda)$, and a phase difference between light output from said second optical multi/demultiplexing device is $2\pi\phi_2(\lambda)$, then the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set such

that output intensity of said optical waveguide circuit becomes constant for the wavelength λ.

37. The interferometer optical switch as claimed in claim 7, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device each consist of a phase generating coupler including N + 1 optical couplers (N is a natural number), and N optical delay lines sandwiched between adjacent said optical couplers of said N + 1 optical couplers, and wherein

the power coupling ratios of the N + 1 optical couplers of said first optical multi/demultiplexing device are made equal to the power coupling ratios of the N + 1 optical couplers of said second optical multi/demultiplexing device.

38. The interferometer optical switch as claimed in claim 37, wherein assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference

$2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

39. The interferometer optical switch as claimed in claim 38, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

40. The interferometer optical switch as claimed in claim 38, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

41. The interferometer optical switch as claimed in claim 38, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

42. The interferometer optical switch as claimed in claim 37, wherein assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

43. A variable optical attenuator that uses the interferometer optical switch as defined in claim 1 wherein, the output intensity is varied.

44. The variable optical attenuator as claimed in claim 43, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes

wavelength insensitive.

45. The variable optical attenuator as claimed in claim 44, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

46. The variable optical attenuator as claimed in claim 44, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

47. The variable optical attenuator as claimed in claim 44, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

48. The variable optical attenuator as claimed in claim 43, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

49. The variable optical attenuator as claimed in claim 43, wherein

said phase generating coupler is configured by connecting optical couplers and optical delay lines.

50. The variable optical attenuator as claimed in claim 49, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and

the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

51. The variable optical attenuator as claimed in claim 50, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

52. The variable optical attenuator as claimed in claim 50, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

53. The variable optical attenuator as claimed in claim 50, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio

of said second optical multi/demultiplexing device is made unity.

54. The variable optical attenuator as claimed in claim 49, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

55. The variable optical attenuator as claimed in claim 49, wherein

said phase generating coupler comprises N + 1 optical couplers (N is a natural number), and N optical delay lines that connects adjacent optical couplers of said N + 1 optical couplers.

56. The variable optical attenuator as claimed in claim 55, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line

with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

57. The variable optical attenuator as claimed in claim 56, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

58. The variable optical attenuator as claimed in claim 56, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

59. The variable optical attenuator as claimed in claim 56, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

60. The variable optical attenuator as claimed in claim 55, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

61. The variable optical attenuator as claimed in claim 49, wherein

one of said first optical multi/demultiplexing device and said second optical multi/demultiplexing device is an optical coupler with a phase difference $2\pi\phi_c$ (constant), and the other is a phase generating coupler that is composed of two optical couplers and an optical delay line placed between said two optical couplers, and has a phase difference

$2\pi\phi\ (\lambda)$, and wherein

assuming that ΔL is the optical path length difference of the optical delay line, and m is an integer, then the power coupling ratios of the two optical couplers constituting said phase generating coupler, and the optical path length difference of the optical delay line are set to satisfy

$$\phi\ (\lambda) = \Delta L/\lambda + m/2 - \phi_c \qquad (11).$$

62. The variable optical attenuator as claimed in claim 61, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

63. The variable optical attenuator as claimed in claim 61, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

64. The variable optical attenuator as claimed in claim 61, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase

difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

65. The variable optical attenuator as claimed in claim 49, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device are both a phase generating coupler comprising two optical couplers and a single optical delay line placed between said two optical couplers, and wherein

power coupling ratios of the two optical couplers and an optical path length difference of the optical delay line that constitutes the first and second optical multi/demultiplexing device are set such that the sum of the phase difference $2\pi\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $2\pi\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device satisfies

$$\phi_1(\lambda) + \phi_2(\lambda) = \Delta L/\lambda + m/2 \qquad (12)$$

where ΔL is the optical path length difference of said optical delay line, and m is an integer.

66. The variable optical attenuator as claimed in claim 65, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1) \cdot \pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

67. The variable optical attenuator as claimed in claim 65, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive,

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase

differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

68. The variable optical attenuator as claimed in claim 65, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

69. The variable optical attenuator as claimed in claim 49, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device are both a phase generating coupler comprising N + 1 optical couplers (N is a natural number), and N optical delay lines each of which is composed of a first and second optical waveguides, and which connects adjacent optical couplers of the N + 1 optical couplers, and wherein

the sum of the optical path length satisfies either ($\Sigma\delta l_{1,1} > \Sigma\delta l_{2,1}$ and $\Sigma\delta l_{1,2} > \Sigma\delta l_{2,2}$), or ($\Sigma\delta l_{2,1} > \Sigma\delta l_{1,1}$ and $\Sigma\delta l_{2,2} > \Sigma\delta l_{1,2}$)

, where $\Sigma\delta l_{1,1}$ is the sum of optical path length differences of the first optical waveguide constituting the N optical delay lines of said first optical multi/demultiplexing device, $\Sigma\delta l_{2,1}$ is the sum of optical path length differences of the second optical waveguide, $\Sigma\delta l_{1,2}$ is the sum of optical path length differences of the first optical waveguide constituting the N optical delay lines of said second optical multi/demultiplexing device, and $\Sigma\delta l_{2,2}$ is the sum of optical path length differences of the second optical waveguides constituting the N optical delay lines of said second optical multi/demultiplexing device.

70. The variable optical attenuator as claimed in claim 69, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

71. The variable optical attenuator as claimed in claim 70, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

72. The variable optical attenuator as claimed in claim 70, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

73. The variable optical attenuator as claimed in claim 70, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

74. The variable optical attenuator as claimed in claim 69, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

75. The variable optical attenuator as claimed in claim 69, wherein

the power coupling ratios of the N + 1 optical couplers of said first optical multi/demultiplexing device are made equal to the power coupling ratios of the N + 1 optical couplers of said second optical multi/demultiplexing device.

76. The variable optical attenuator as claimed in claim 75, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer), wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal throughout an entire wavelength region.

77. The variable optical attenuator as claimed in claim 75, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer); wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is

the phase produced by the second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive, and wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m' \cdot \pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

78. The variable optical attenuator as claimed in claim 75, wherein

assuming that optical wavelength is λ, a phase difference between light output from said first optical multi/demultiplexing device is $2\pi\phi_1(\lambda)$, a phase difference caused by an optical path length difference ΔL of said optical delay line is $2\pi\phi\Delta_L(\lambda)$, and a phase difference between light output from said second optical multi/demultiplexing device is $2\pi\phi_2(\lambda)$, then the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set such that output intensity of said optical waveguide circuit becomes constant for the wavelength λ.

79. The variable optical attenuator as claimed in claim 49, wherein

said first optical multi/demultiplexing device and said second optical multi/demultiplexing device each consist of a phase generating coupler including N + 1 optical couplers (N is a natural number), and N optical delay lines sandwiched between adjacent said optical couplers of said N + 1 optical couplers, and wherein

the power coupling ratios of the N + 1 optical couplers of said first optical multi/demultiplexing device are made equal to the power coupling ratios of the N + 1 optical couplers of said second optical multi/demultiplexing device.

80. The variable optical attenuator as claimed in claim 79, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$ is the phase produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the phase produced by the first and second optical multi/demultiplexing device and the optical path length difference ΔL is set such that the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ becomes wavelength insensitive.

81. The variable optical attenuator as claimed in claim 80, wherein

the sum of the phase difference $\phi_1(\lambda)$ of the output of said first optical multi/demultiplexing device and the phase difference $\phi_2(\lambda)$ of the output of said second optical multi/demultiplexing device equals $\Delta L/\lambda + m/2$ (m is an integer).

82. The variable optical attenuator as claimed in claim 80, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $(2m' + 1)\cdot\pi$ (m' is an integer), and the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device are made equal.

83. The variable optical attenuator as claimed in claim 80, wherein

the sum $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ of the three phase differences is set at $2m'\cdot\pi$ (m' is an integer), and the sum of the power coupling ratio of said first optical multi/demultiplexing device and the power coupling ratio of said second optical multi/demultiplexing device is made unity.

84. The variable optical attenuator as claimed in claim 79, wherein

assuming that λ is the wavelength, $2\pi\phi_1(\lambda)$is the phase

produced by the first optical multi/demultiplexing device, $2\pi\phi\Delta_L(\lambda)$ is the phase difference of the optical delay line with an optical path length difference of ΔL, and $2\pi\phi_2(\lambda)$ is the phase produced by the second optical multi/demultiplexing device, the sum of the phase difference $2\pi\{\phi_1(\lambda) + \phi\Delta_L(\lambda) + \phi_2(\lambda)\}$ is set such that the output intensity of said optical waveguide circuit becomes uniform with respect to wavelength.

85. An interferometer optical switch comprising a plurality of interferometer optical switches as defined in any one of claims 1-42 connected in cascade.

86. A variable optical attenuator comprising a plurality of variable optical attenuators as defined in any one of claims 43-84 connected in cascade.

87. An interferometer optical switch comprising an optical circuit having a plurality of interferometer optical switches as defined in any one of claims 1-42 connected in cascade, wherein

a first interferometer optical switch having two output waveguides;

one of the said output waveguides is connected to the input waveguide of a second interferometer optical switch;

the other output waveguide of said first interferometer optical switch is used as the second output port of said

optical circuit;

the input waveguide of said first interferometer optical switch is used as the input port of said optical circuit; and

the output waveguide of said second interferometer optical switch is used as the first output port of said optical circuit.

88. A variable optical attenuator comprising an optical circuit having a plurality of variable optical attenuators as defined in any one of claims 43-84 connected in cascade, wherein

a first interferometer optical switch having two output waveguides;

one of the said output waveguides is connected to the input waveguide of a second interferometer optical switch;

the other output waveguide of said first interferometer optical switch is used as the second output port of said optical circuit;

the input waveguide of said first interferometer optical switch is used as the input port of said optical circuit; and

the output waveguide of said second interferometer optical switch is used as the first output port of said optical circuit.

89. An interferometer optical switch comprising an optical circuit having a plurality of interferometer optical switches as defined in any one of claims 1-42 connected

in cascade, wherein

a first interferometer optical switch having two output waveguides;

one of the said output waveguides is connected to the input waveguide of a second interferometer optical switch;

the other output waveguide of said first interferometer optical switch is connected to the input waveguide of a thirdinterferometer optical switch;

the input waveguide of said first interferometer optical switch is used as the input port of said optical circuit;

the output waveguide of said second interferometer optical switch is used as the first output port of said optical circuit; and

the output waveguide of said third interferometer opticalswitch is used as the second output port of said optical circuit.

90. A variable optical attenuator comprising an optical circuit having a plurality of optical variable attenuates as defined in any one of claims 43-84 connected in cascade, wherein

a first interferometer optical switch having two output waveguides;

one of the said output waveguides is connected to the input waveguide of a second interferometer optical switch;

the other output waveguide of said first interferometer optical switch is connected to the input waveguide of a

thirdinterferometer optical switch;

the input waveguide of said first interferometer optical switch is used as the input port of said optical circuit;

the output waveguide of said second interferometer optical switch is used as the first output port of said optical circuit; and

the output waveguide of said third interferometer opticalswitch is used as the second output port of said optical circuit.

91. An interferometer optical switch using at least one interferometer optical switch as defined in any one of claims 1-42 to configure an optical switch with M inputs (M: natural number) and N outputs (N: natural number).

92. A variable optical attenuator using at least one variable optical attenuator as defined in any one of claims 43-84 to configure an optical switch with M inputs (M: natural number) and N outputs (N: natural number).

93. The interferometer optical switch as claimed in any one of claims 1-42, wherein

said optical coupler consists of a directional coupler including two optical waveguides placed side by side in close proximity.

94. The variable optical attenuator as claimed in any one

of claims 43-84, wherein

said optical coupler consists of a directional coupler including two optical waveguides placed side by side in close proximity.

95. The interferometer optical switch as claimed in any one of claims 1-42, wherein

said phase shifter consists of a thin film heater formed on the optical waveguide.

96. The variable optical attenuator as claimed in any one of claims 43-84, wherein

said phase shifter consists of a thin film heater formed on the optical waveguide.

97. The interferometer optical switch as claimed in any one of claims 1-42, wherein

said phase shifter consists of a thin film heater formed on the optical waveguide, and an adiabatic groove is formed near said thin film heater.

98. The variable optical attenuator as claimed in any one of claims 43-84, wherein

said phase shifter consists of a thin film heater formed on the optical waveguide, and an adiabatic groove is formed near said thin film heater.

99. The interferometer optical switch as claimed in any one of claims 1-42, wherein

said optical waveguide circuit is made of a silica-based glass optical waveguide.

100. The variable optical attenuator as claimed in any one of claims 43-84, wherein

said optical waveguide circuit is made of a silica-based glass optical waveguide.

101. The interferometer optical switch as claimed in any one of claims 1-42, wherein

said interferometer optical switch has birefringent index adjustment means on its optical waveguide, or undergoes adjustment of a birefringent index.

102. The variable optical attenuator as claimed in any one of claims 43-84, wherein

said variable optical attenuator has birefringent index adjustment means on its optical waveguide, or undergoes adjustment of a birefringent index.

103. An optical module comprising a module including within it an interferometer optical switch as defined in any one of claims 1-42, and optical fibers that are held by said module for inputting and outputting a signal to and from said interferometer optical switch.

104. An optical module comprising a module including within it a variable optical attenuator as defined in any one of claims 43-84, and optical fibers that are held by said module for inputting and outputting a signal to and from said variable attenuator.